

Amendments to the Claims:

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (original): In a gas discharge excimer laser having a master oscillator portion, producing narrow band seed laser light output pulses, and a power amplifier portion, receiving and amplifying the narrow band seed laser light output pulses into power amplifier laser light output pulses, operating at power amplifier laser light output pulse repetition rates greater than or equal to 4000 per second, in a burst of pulses during an on period, followed by an off period, and having an electrical discharge pulse power system converting energy stored on respective master oscillator and power amplifier charging capacitors into very high voltage, short duration electrical discharge pulses across respective gas discharge electrodes in each of the master oscillator and power amplifier, through respective master oscillator and power amplifier multi-stage electrical discharge magnetic pulse compression circuitry and an electrical discharge pulse fractional turn voltage step-up transformer, an apparatus for controlling the timing of the release of the energy stored on the respective master oscillator and power amplifier charging capacitors in order to control the timing of the application of the electrical gas discharge pulse across the respective master oscillator and power amplifier electrodes, comprising:

- a respective master oscillator delay command unit and power amplifier delay command unit providing a respective timing control signal to the respective master oscillator and power amplifier, determining the timing of the release of the energy stored on the respective master oscillator and power amplifier charging capacitors, based upon an initial optimal delay command value;
- a laser output pulse sensor sensing a parameter of the output seed laser light pulses and amplified laser light output pulses, and providing a respective output representative of the value of the respective parameter;
- a respective master oscillator and power amplifier adaptation gain unit containing a respective master oscillator adaptation gain value and power amplifier adaptation gain value;

Atty. Docket No. 2003-0025-02
USSN 10/631,349

a dithering circuit responsive to the output of the respective output pulse sensor to provide an N-plus integral value to be combined with the respective adaptation gain value in order to produce a respective delay command.

2. (original): In a gas discharge excimer laser having a master oscillator portion, producing narrow band seed laser light output pulses and a power amplifier portion, receiving and amplifying the narrow band seed laser light output pulses into power amplifier laser light output pulses, operating at power amplifier laser light output pulse repetition rates greater than or equal to 4000 per second, in a burst of pulses during an on period, followed by an off period, and having an electrical discharge pulse power system converting energy stored on respective master oscillator and power amplifier charging capacitors into very high voltage, short duration electrical discharge pulses across gas discharge electrodes in each of the master oscillator and power amplifier, through a respective master oscillator and power amplifier multi-stage electrical discharge magnetic pulse compression circuitry and electrical discharge pulse fractional turn voltage step-up transformer, an apparatus for controlling the amount of power amplifier laser output light in the form of broadband amplified stimulated emission, comprising:

a gas discharge timing unit controlling the timing of the respective discharge in the master oscillator and in the power amplifier, comprising:

a clock providing time information to the gas discharge timing unit;

a clock triggering mechanism triggering the clock when the off period begins;

a time counter in the gas discharge timing unit providing an indication that time on the clock exceeds a selected threshold and providing a time out signal to the gas discharge timing unit when the time on the clock exceeds the selected threshold; and,

a gas discharge timing controller initiating gas discharge in the power amplifier sufficiently before or sufficiently after the discharge of the master oscillator, for at least a first discharge of the master oscillator and power amplifier after the end of the off period, to essentially prevent any significant occurrence of broadband amplified stimulated emission in the power amplifier during the at least the first discharge.

Atty. Docket No. 2003-0025-02
USSN 10/631,349

3. (original): The apparatus of claim 2 further comprising the threshold is selected such that the gas discharge timing controller initiates the discharge in the power amplifier sufficiently before or sufficiently after the discharge in the master oscillator for the at least the first pulse in a burst when there is a separation between bursts of a predetermined time period.

4. (original): The apparatus of claim 2 further comprising the threshold is selected such that the gas discharge timing controller initiates the discharge in the power amplifier sufficiently before or sufficiently after the discharge in the master oscillator for the at least the first pulse in a burst for essentially all bursts, regardless of the time separating each burst.

5-23. (cancelled)

24. (previously presented): A gas discharge laser timing control system for a two chambered gas discharge laser system operating at discharge repetition rates of in excess of 3000 Hz and having a first chamber providing a seed laser beam to a second amplifying chamber, with each of the first chamber and second chamber receiving a pulse of electrical energy across a respective pair of discharge electrodes, after a respective initial charging capacitor in a respective electrical pulse energy source is charged from a charging circuit, and after the triggering of a first solid state switch connected to the respective electrical pulse energy source for the first chamber and after the triggering of a second solid state switch connected to the respective electrical pulse energy source for the second chamber, comprising:

a fire control command module receiving a first fire control input signal and, responsive to the first fire control input signal, providing a charging initiation signal to the charging circuit, and a preselected time later providing a fire control initiation signal to a timing energy module;

the fire control command module also providing to the timing energy module a first time delay signal to be added to the fire control initiation signal to provide a trigger

Atty. Docket No. 2003-0025-02
USSN 10/631,349

signal for the first chamber and a second time delay signal to be added to the fire control initiation signal to provide a trigger signal for the second chamber;

a first light out detection mechanism measuring a light out event for the output of the first chamber and a second light out detection mechanism measuring a light out event for the output of the second chamber, each of the first and second light out detection mechanisms providing an output signal representative of the occurrence of the respective light out event to the timing energy module;

a correlating mechanism in the timing energy module correlating the occurrence of the respective light out events of the first chamber and the second chamber to the fire control initiation signal, and providing to the fire control command module, a respective light out time for the first chamber and for the second chamber, each respective light out time correlated to the fire control initiation signal;

a fire control processor connected to the fire control command module and operative to read the respective correlated light out time for each of the first chamber and the second chamber and, responsive to the respective correlated light out time, to generate a respective first time delay signal and second time delay signal for the next discharge in the respective first chamber and in the second chamber.

25. (previously presented): The apparatus of claim 24 further comprising:
the respective correlated light out time for the first chamber and for the second chamber is provided by the timing energy module to the fire control processor with an accuracy of less than one nanosecond.

26. (previously presented): The apparatus of claim 24 further comprising:
the correlation mechanism is a timer;
the timing energy module commences the running of the timer in response to receipt of the fire control initiation signal from the fire control command module.

27. (previously presented): The apparatus of claim 25 further comprising:
the correlation mechanism is a timer;

Atty. Docket No. 2003-0025-02
USSN 10/631,349

the timing energy module commences the running of the timer in response to receipt of the fire control initiation signal from the fire control command module.

28. (previously presented): The apparatus of claim 24 further comprising: the light out event detection mechanism measures the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.

29. (previously presented): The apparatus of claim 25 further comprising: the light out event detection mechanism measures the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.

30. (previously presented): The apparatus of claim 26 further comprising: the light out event detection mechanism measures the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.

31. (previously presented): The apparatus of claim 27 further comprising: the light out event detection mechanism measures the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.

32. (previously presented): The apparatus of claim 24 further comprising: the light out event detection mechanism measures the occurrence of a voltage in the respective electrical pulse energy source exceeding a preselected threshold.

33. (previously presented): The apparatus of claim 25 further comprising: the light out event detection mechanism measures the occurrence of a voltage in the respective electrical pulse energy source exceeding a preselected threshold.

Atty. Docket No. 2003-0025-02
USSN 10/631,349

34. (previously presented): The apparatus of claim 26 further comprising:
the light out event detection mechanism measures the occurrence of a voltage in
the respective electrical pulse energy source exceeding a preselected threshold.

35. (previously presented): The apparatus of claim 27 further comprising:
the light out event detection mechanism measures the occurrence of a voltage in
the respective electrical pulse energy source exceeding a preselected threshold.

36. (previously presented): The apparatus of claim 32 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the
respective pair of electrodes in the first and second chambers.

37. (previously presented): The apparatus of claim 33 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the
respective pair of electrodes in the first and second chambers.

38. (previously presented): The apparatus of claim 34 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the
respective pair of electrodes in the first and second chambers.

39. (previously presented): The apparatus of claim 35 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the
respective pair of electrodes in the first and second chambers.

40. (previously presented): The apparatus of claim 26 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

41. (previously presented): The apparatus of claim 27 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

Atty. Docket No. 2003-0025-02
USSN 10/631,349

42. (previously presented): The apparatus of claim 28 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

43. (previously presented): The apparatus of claim 29 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

44. (previously presented): The apparatus of claim 30 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

45. (previously presented): The apparatus of claim 31 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

46. (previously presented): The apparatus of claim 32 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

47. (previously presented): The apparatus of claim 33 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

48. (previously presented): The apparatus of claim 34 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

49. (previously presented): The apparatus of claim 35 further comprising:

Atty. Docket No. 2003-0025-02
USSN 10/631,349

the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

50. (previously presented): The apparatus of claim 36 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

51. (previously presented): The apparatus of claim 37 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

52. (previously presented): The apparatus of claim 38 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

53. (previously presented): The apparatus of claim 39 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

54. (previously presented): The apparatus of claim 50 further comprising:
an oscillator circuit having a clock range in the tens of megaHz;
a linear analog capacitive element charged by output pulses from the oscillator circuit;
a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.

55. (previously presented): The apparatus of claim 51 further comprising:
an oscillator circuit having a clock range in the tens of megaHz;
a linear analog capacitive element charged by output pulses from the oscillator circuit;

Atty. Docket No. 2003-0025-02
USSN 10/631,349

a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.

56. (previously presented): The apparatus of claim 52 further comprising:
an oscillator circuit having a clock range in the tens of megaHz;
a linear analog capacitive element charged by output pulses from the oscillator circuit;

a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.

57. (previously presented): The apparatus of claim 53 further comprising:
an oscillator circuit having a clock range in the tens of megaHz;
a linear analog capacitive element charged by output pulses from the oscillator circuit;

a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.

58. (previously presented): A timing control method for a two chambered gas discharge laser system operating at discharge repetition rates of in excess of 3000 Hz and having a first chamber providing a seed laser beam to a second amplifying chamber, with each of the first chamber and second chamber receiving a pulse of electrical energy across a respective pair of discharge electrodes, after a respective initial charging capacitor in a respective electrical pulse energy source is charged from a charging circuit, and after the triggering of a first solid state switch connected to the respective electrical pulse energy source for the first chamber and after the triggering of a second solid state switch connected to the respective electrical pulse energy source for the second chamber, comprising:

Atty. Docket No. 2003-0025-02
USSN 10/631,349

using a fire control command module, receiving a first fire control input signal and, responsive to the first fire control input signal, providing a charging initiation signal to the charging circuit, and at a preselected time later providing a fire control initiation signal to a timing energy module;

using the fire control command module, also providing to the timing energy module a first time delay signal to be added to the fire control initiation signal to provide a trigger signal for the first chamber and a second time delay signal to be added to the fire control initiation signal to provide a trigger signal for the second chamber;

measuring a first light out event for the output of the first chamber and a second light out event for the output of the second chamber, and providing an output signal representative of the occurrence of the respective first and second light out events to the timing energy module;

using a correlating mechanism in the timing energy module, correlating the occurrence of the respective light out events of the first chamber and the second chamber to the fire control initiation signal, and providing to the fire control command module a respective light out time for the first chamber and for the second chamber, each respective light out time correlated to the fire control initiation signal;

in a fire control processor connected to the fire control command module reading the respective correlated light out time for each of the first chamber and the second chamber and, responsive to the respective correlated light out time, generating a respective first time delay signal and second time delay signal for the next respective discharge in the first chamber and in the second chamber.

59. (previously presented): The method of claim 58 further comprising:

providing the respective correlated light out time for the first chamber and for the second chamber to the timing energy module to the fire control processor with an accuracy of less than one nanosecond.

60. (previously presented): The method of claim 58 further comprising:

commencing the running of a timer in the timing energy module in response to receipt of the fire control initiation signal from the fire control command module.

Atty. Docket No. 2003-0025-02
USSN 10/631,349

61. (previously presented): The method of claim 59 further comprising:
commencing the running of a timer in the timing energy module in response to receipt of the fire control initiation signal from the fire control command module.
62. (previously presented): The method of claim 58 further comprising:
detecting the light out event by measuring the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.
63. (previously presented): The method of claim 59 further comprising:
detecting the light out event by measuring the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.
64. (previously presented): The method of claim 60 further comprising:
detecting the light out event by measuring the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.
65. (previously presented): The method of claim 61 further comprising:
detecting the light out event by measuring the occurrence of light in the respective chamber or at the output of the respective chamber exceeding a preselected threshold intensity.
66. (previously presented): The method of claim 58 further comprising:
detecting the light out event by measuring the occurrence in the respective chamber of a voltage in the respective electrical pulse energy source exceeding a preselected threshold.
67. (previously presented): The method of claim 59 further comprising:

Atty. Docket No. 2003-0025-02
USSN 10/631,349

detecting the light out event by measuring the occurrence in the respective chamber of a voltage in the respective electrical pulse energy source exceeding a preselected threshold.

68. (previously presented): The method of claim 60 further comprising:
detecting the light out event by measuring the occurrence in the respective chamber of a voltage in the respective electrical pulse energy source exceeding a preselected threshold.

69. (previously presented): The method of claim 61 further comprising:
detecting the light out event by measuring the occurrence in the respective chamber of a voltage in the respective electrical pulse energy source exceeding a preselected threshold.

70. (previously presented): The method of claim 66 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the respective pair of electrodes in the first and second chambers.

71. (previously presented): The method of claim 67 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the respective pair of electrodes in the first and second chambers.

72. (previously presented): The method of claim 68 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the respective pair of electrodes in the first and second chambers.

73. (previously presented): The method of claim 69 further comprising:
the voltage is the respective peaking capacitor voltage being applied to the respective pair of electrodes in the first and second chambers.

74. (previously presented): The method of claim 60 further comprising:

Atty. Docket No. 2003-0025-02
USSN 10/631,349

the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

75. (previously presented): The method of claim 61 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

76. (previously presented): The method of claim 62 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

77. (previously presented): The method of claim 63 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

78. (previously presented): The method of claim 64 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

79. (previously presented): The method of claim 65 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

80. (previously presented): The method of claim 66 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

81. (previously presented): The method of claim 67 further comprising:
the respective first and second time delay signal is a respective count which the timer is to reach whereupon the respective trigger signal is to be generated.

Atty. Docket No. 2003-0025-02
USSN 10/631,349

82. (previously presented): The method of claim 68 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

83. (previously presented): The method of claim 69 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

84. (previously presented): The method of claim 70 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

85. (previously presented): The method of claim 71 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

86. (previously presented): The method of claim 72 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

87. (previously presented): The method of claim 73 further comprising:
the respective first and second time delay signal is a respective count which the
timer is to reach whereupon the respective trigger signal is to be generated.

88. (previously presented): The method of claim 84 further comprising:
using an oscillator circuit having a clock range in the tens of megaHz;
charging a linear analog capacitive element with the output pulses of the oscillator
circuit;
using a voltage sensing mechanism operatively connected to the capacitive
element and sensitive to voltage variation in the energy stored in the capacitive element
to a sensitivity that results in sub-nanosecond time resolution accuracy.

Atty. Docket No. 2003-0025-02
USSN 10/631,349

89. (previously presented): The method of claim 85 further comprising:
using an oscillator circuit having a clock range in the tens of megaHz;
charging a linear analog capacitive element with the output pulses of the oscillator circuit;

using a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.

90. (previously presented): The method of claim 86 further comprising:
using an oscillator circuit having a clock range in the tens of megaHz;
charging a linear analog capacitive element with output pulses from the oscillator circuit;

using a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.

91. (previously presented): The method of claim 87 further comprising:
using an oscillator circuit having a clock range in the tens of megaHz;
charging a linear analog capacitive element with output pulses from the oscillator circuit;
using a voltage sensing mechanism operatively connected to the capacitive element and sensitive to voltage variation in the energy stored in the capacitive element to a sensitivity that results in sub-nanosecond time resolution accuracy.